Bull. Bot. Surv. India

Vol. 28, Nos. 1-4 : pp. 229-240, 1986

THE GRASS FLORA OF INDIA — A SYNOPTIC ACCOUNT OF USES AND PHYTOGEOGRAPHY

S. K. JAIN*

National Botanical Research Institute, Lucknow

ABSTRACT

Gramineae is the fourth largest family of flowering plants; it has about 700 genera and 10,000 species in the world. Grasses are economically very important as major cereals like wheat, rice and maize are grasses, as are also the sugarcane and bamboos; they bind soil. Grasses provide variety of other useful products for food, fodder, oils, house-building, and for lawn making, etc. India has about 266 genera and 1200 species. The list of genera is appended.

About 360 grass taxa are endemic to India. Rich diversity and endemism suggest that some grass genera, like *Isachne, Dichanthium, Ischaemum, Dimeria* and *Arthraxon* might have had their primary or secondary centre of origin in India.

Several grasses are now rare and threatened. A list of about one hundred grasses which are endemic and also rare is appended.

It is emphasized that revisionary studies on large genera are necessary for better evaluation of diversity and endemism.

INTRODUCTION

About 24 percent of earth's vegetation cover comprises of grasses. The cereals which provide food (like rice, wheat, corn, barley, oats, millets), the major fodders, sugarcane and bamboos are all grasses.

In the terms of world production of crops, the first four, viz. sugarcane, wheat, rice and maize are grasses-grasses are the main constituents of grasslands and pastures which support the animals, who in turn, provide milk, other dairy products, wool, meat and leather Grasses bind soil on mountain slopes, riverbanks, and in plains; they make lawns and hold even sandy plains and dunes.

Grasses can be easily distinguished from all other groups of plants by their characteristic habit, leaves and inflorescence. Some grasses superficially resemble sedges, but differ in having jointed, round and hollow stems and leaves placed alternately on opposite sides of the stem. Grasses belong to the monocotyledonous group of plants. They have an embryo having a single cotyledon, stems having irregularly scattered woody fibres; these stems do not increase in thickness with age. These characters are in contrast to the dicotyledons which have an embryo with two cotyledons, stems with woody fibres in a zone between pith and bark, and with age increase in thickness.

The family of grasses, namely the Gramineae (alternative name Poaceae) is the fourth largest family of flowering plants, having over 700 genera and 10,000 species in the world.

---

*Ex-Director, Botanical Survey of India.

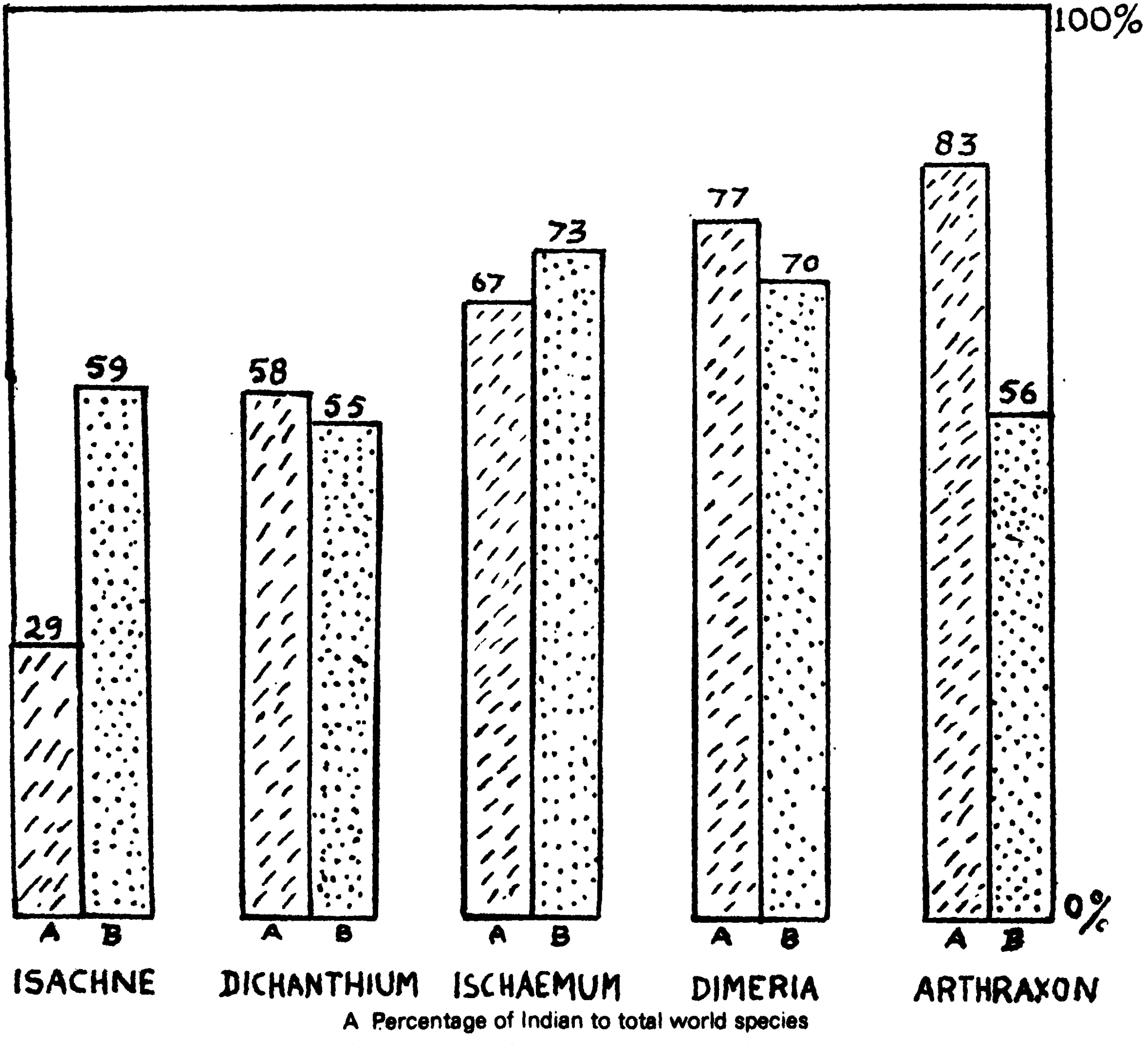
In India grasses form the largest family of flowering plants. Out of an estimated 15,000 species of flowering plants, nearly eight percent, *i.e.* about 1200 are grasses.

The bamboos being the most conspicuous and economically important among the wild members of Gramineae first received attention and a number of papers were written on this group in India.

One of the earliest works on the wild grasses in India is by Griffith (1834) who described the grasses of Jheels of Sylhet district. During 1881-1896 several workers such as Ferguson (1881), Symonds (1886), Duthie (1883, 1886, 1888), Coldstream (1889) and Lisboa (1896) collected, studied and wrote about the grasses of different regions of India and Sri Lanka. The 19th century ended with the consolidated account of the Gramineae of India in Hooker's *Flora of British India* (Hooker & Stapf, 1896).

Intensive study of grasses was made by Blatter, McCann and their co-workers. Their studies culminated in the excellent account of grasses of Bombay published in 1935. Achariar and Mudaliar (1921) and Fischer (1934) studied the grasses of Madras and adjacent states.

Among the foremost recent workers



A Percentage of Indian to total world species

B Percentage of endemic to total world species on Indian grasses stands out the name of N. L. Bor, who made extensive collections in Assam, Uttar Pradesh and Himalayas and has written about 125 papers on Indian grasses. His monumental works on Indian grasses are the *Grasses of Assam* (1940), the *Common Grasses of Uttar Pradesh* (1941) and finally a consolidated concise account of grasses of the whole Indian subcontinent (1960). He revised a large number of Indian grass genera; notable among them are *Cymbopogon, Poa, Hystrix, Aeluropus, Aristida, Arundinella* and *Digitaria.*

Several other workers have made valuable contributions during last 20 years. Raizada, Jain & Bhardwaja (1961, 1964) studied the grasses of Upper Gangetic Plains and prepared a profusely illustrated detailed account. This work supplements the unfinished Duthie's Flora of the Upper Gangetic Plains. They also wrote on the nomenclature of several Indian grass genera, *e.g. Capillipedium, Ischaemum, Eremopogon* and *Schizachyrium.* They described several new species, new records and new names among Indian grasses.

Kapadia (1945), Desai & Murthy (1950) and Majumdar (1956) published account of grasses of Junagadh (Gujarat), Dharwar, (Karnataka) and 24-Parganas (West Bengal), respectively. Tiwari (1954-1955) gave an account of the grasses of Madhya Pradesh, Chaudhury (1959, 1960) studied the grasses of West Bengal. Some other notable floristic accounts on grasses of India are *Grasses of Marathwada* (Patunkar 1980) and *Grasses of Madhya Pradesh* (Roy 1984). Jain and his co-workers have published about 50 papers on Indian grasses. In 1961 and 1972 he published the bibliography of the family Gramineae, and in 1975 an account of grasses of Bengal, Bihar and Orissa. Ved Prakash *et al.* (1977) published a list of about one hundred additions (and new names) in Indian grasses after Bor's work of 1960. Jain & Srivastava (1986) produced second list of about 90 taxa as additions to Indian grass flora.

The only notable publications on revisions are by Jain (and his associates) on *Cynodon* (1967a), on *Oropetium* (1967b), on *Manisuris* (1970) on *Arthraxon* (1972), on *Anthoxanthum* (1975), on tribe Garnotieae and on *Isachneae* (1984) and by Deshpande on *Dichanthium* (1984).

Economic importance of grasses:

The most important grasses in India are the cereals such as rice or 'dhan' *(Oryza sativa),* wheat or 'gehun' *(Triticum aestivum),* millets (such as Pearl millet or 'bajra' *(Pennisetum typhoides)* maize or 'maki' *(Zea mays),* giant millet or 'jowar' *(Sorghum),* barley or 'jaun' *(Hordeum vulgare),* and common millet *(Panicum miliaceum),* sugarcane, 'ikh' *(Saccharum officinarum)* and bamboos. In rural areas, many lesser important millet such as finger millet or 'ragi' *(Eleusine coracana)* and 'kodo' *(Paspalum scrobiculatum)* are also grown. Grasses of comparatively restricted cultivation are the oat or 'jai' *(Avena sativa)* in north-western Himalaya, and finger-grass *(Digitaria cruciata* var. *esculenta)* in the Khasi Hills.

A number of wild grasses are used as fodder. *e.g.* thatch grass 'tairu' *(Imperata cylindrica),* 'Kans' *(Saccharum spontaneum)* and 'dub' *(Cynodon dactylon)* are the commonest in the plains. In moist regions in the plains, species of 'Sandhor' *(Dichanthium),* 'Anjan' *(Cenchrus),* 'bamna' *(Chloris),* 'dub' *(Cynodon),* 'makra' *(Dactyloctenium),* 'sawan' *(Echinochloa), Eragrostis,* panic *(Panicum)* foxtail *(Setaria)* and 'ula' *(Themeda),* and in drier regions and on the seashore, species of *Aeluropus,* 'lappa' *(Aristida), Chloris,* lemon grass *(Cymbopogon)* 'dheb' *(Desmostachya),* 'dhanua' *(Ischaemum)* and *Sporobolus,* etc. are common.

In moist hilly areas, species of white bent-grass *(Agrostis),* brome *(Bromus),* eye-grass *(Lolium)*, napier *(Pennisetum)*, canary grass *(Phalaris)*, *Poa* and *Trisetum* occur commonly. Species of *Pennisetum*, *Stipa*, brome 'Sandhor' and fescue *(Festuca)*, are common in dry regions in hills.

Several exotic species are being cultivated for fodder and have given good results, but many indigenous species are very suitable for the purpose. Kikuyu *(Pennisetum)* has been introduced in many areas in the hills, particularly in Sikkim.

As regards lawns, 'Dub' is the commonest grass used for the purpose. In areas of high rainfall, thatch grass and 'kush' *(Chrysopogon aciculatus)* provide good lawns. *Axonopus compressus* is also suitable. But these grasses need to be regularly mown to avoid tall growth.

Many grass species yield valuable essential oils; the genera *Cymbopogon, Vetiveria* and *Dichanthium* are particularly important. The aromatic oils in these species are obtained by steam-distillation.

Bamboos are the main source of paper; in addition, species of *Themeda, Saccharum*, 'sabai' *(Eulaliopsis)* 'nal' *(Arundo)* and reed *(Phragmites)* have been shown to be suitable for the purpose.

Grasses have been widely employed for soil conservation. In drier areas, *Panicum, Lasiurus* and *Cenchrus* have been recommended for stabilizing sand-dunes. On the coasts, *Spinifex* and *Thauarea* help in stabilization of sand.

Some grasses are useful in medicines:

Grasses are put to a number of other miscellaneous uses such as for making brooms and ropes, for matting and thatching purposes and for stuffing pillows. The common grasses used for thatching are *Imperata, Andropogon, Saccharum spontaneum* and *Desmostachya*. Bamboo strips are the most commonly used material for the framework of walls. Culms of 'nal' and reed, 'kans' and species of *Themeda* are also largely used as reeds for the framework of huts. Bamboos provide most of the material for matting but reed and 'nal' are also used. 'Sabai', 'kans' and *Desmostachya* are largely used for making ropes.

Many wild grasses help in breeding improved varieties of cereal and fodder crops, particularly for hardiness and disease resitance. Culms of *Vetiveria zizanioides* are used for making screens in summer. Fruits of *Coix* and a few others provide beads for necklaces.

Some members of this family are also harmful to man and his cattle. Certain species of *Lolium* and *Sorghum* are reported to be poisonous to livestock. Many grow as weeds in agricultural fields, *e.g. Echinochloa* and *Isachne* infest rice fields and *Alopecurus, Lolium*, and *Secale* commonly infest wheat-fields. Grasses with sharp awns *e.g.* of the genera *Heteropogon, Aristida, Chrysopogon* and *Themeda* and fruits of *Cenchrus* cause mechanical injuries to cattle either through contact or grazing.

Synoptic Taxonomic Account:

It is assessed that presently about 1055 species belonging to 266 genera of grasses naturally occur in India and another about 130 species have been introduced; some of the latter have now naturalized.

The list of the genera of grasses of India is given in Appendix I. The number of species in India is indicated against each genus. The figure in bracket indicates the number of exotics introduced and/or naturalized in India.

In a few cases, like in *Cymbopogon* and *Digitaria* the taxonomic status of certain varieties or subspecies and their natural occurrence in India is not very clear and certain, and the number of species is only approximate.

Endemism:

Grasses show fairly rich endemism in India. Approximately 430 taxa of grasses were reported in literature as endemic to present boundaries of India (Jain & Rao 1983).

A critical examination of the literature and herbarium materials for distribution and taxonomy shows that about 70 taxa were erroneously considered to be endemic (Jain, 1986). They fall in one or the other of the following categories :

1. They extend to neighbouring or other countries, *e.g. Agrostis inequiglumis* Griseb. is reported from Nepal and *Chimonobambusa densiflora* (Munro) Nakai occurs in Sri Lanka.
2. The taxa are reduced to the synonymy of some non-endemic taxa, *e.g. Deyeuxia simlensis* Bor considered endemic to Himachal Pradesh is synonymous with *D. scabrescens* (Griseb.) Munro ex Duthie which extends northwestwards to Pakistan. *Dichanthium palidum* (Hook. f.) Stapf ex Fischer considered endemic to Nilgiris is now treated as synonymous to *D. caricosum* (L.) Camus which is a wide species.
3. Some taxa were known from neighbouring regions for long time, and somehow that literature was not consulted and the taxa were considered endemic, *e.g. Chimonobambusa khasiana* (Munro) Nakai was collected from Burma in 1915 and recorded by Rhind (1945), but even very recently it was reported endemic to India (Kartikeyan, 1983). The same is the case of *Isachemum molle* Hook. f.

Presently, over 350 taxa of grasses, *i.e.* about 30 percent of Indian grass flora are endemic to Indian boundaries. It is estimated that 172 endemics occur in peninsular region, 56 in northeast, 30 in northwest, 12 in lower Gangetic plain, 5 in western arid regions, 4 in Andaman and Nicobar islands and 50 spread to more than one of the above regions.

Centre of origin :

The occurrence of large number of species, high endemism and discovery of many new taxa from India suggests the possibility of primary or secondary centre of origin of at least the following genera in the Indian region : *Arthraxon, Dichanthium, Dimeria, Isachne,* and *Ischaemum.*

The following 16 genera are wholly endemic to India :

Bhidea
Chandrasekharania
Cyathopus
Danthonidium
Glyphochloa
Hubbardia
Indopoa
Limnopoa
Manisuris
Normanboria
Pogonachne
Pseudodanthonia
Pseudodichanthium
Silentvalleya
Trilobachne
Triplopogon

In addition, 73 more genera of grasses have one or more endemic species.

Rarity and Conservation :

Threats to plant cover have not spared grasses. Many grass species have become rare, endangered and some perhaps extinct.

The preliminary *State-of-Art Report on Threatened plants of India* (Jain & Sastry 1980) included only two grass species namely *Phyllostachys bambusoides.* Sieb. & Zucc. and *Glyphochloa divergens* (Hook.f.) Clayton (under generic name

Manisuris). This is not the correct position today and, dozens of species are known only by their first collection, that is type specimens in herbaria. There is no evidence of their survival in nature or any conservatory.

Panicum, Pennisetum, Poa, Setaria, Sporobolus, Stipa and *Themeda.*

This can result in discovery of new taxa, understanding of endemism and diversity and better evaluation of their economic aspects.

The table below shows the number of species in world, in India and endemics in India, as also the percentages in these genera.

	Spp. in World	Spp. in India	A % Indian to World spp.	Endemic	B % Endemic to Indian spp.
Isachne	100	29	29%	17	59%
Dichanthium	50	29	58%	16	55%
Ischaemum	60	40	67%	29	73%
Dimeria	35	27	77%	19	70%
Arthraxon	30	25	83%	14	56%

A & B refer to columns in the histogram, Plate 1

A few examples are *Hubbardia heptaneuron* Bor, *Isachne deccanensis* Bor and *Gigantochloa tekserah* Camus.

A list of some rare taxa which are also endemic is given in Appendix II. (Jain & Sastry, 1983).

Phytogeographical Affinities :

Among the wide species of grasses, 81 show affinity with Irano-Turanian, 50 with Sino-Japanese, 29 with Indochinese and 28 with Euro-Siberian floras.

Discussion :

India is rich in grass flora; the latter includes many economically important species. Many species are rare and endangered.

The observations and analysis given above show the urgent need of monographic studies on larger and economically important genera, like *Brachiaria, Bromus, Chrysopogon, Digitaria, Dimeria, Elymus, Eragrostis, Eulalia, Festuca, Ischaemum,*

ACKNOWLEDGEMENTS

This study was done as the Pitambar Pant National Environment Fellow (1984-86), and the author is grateful to the Department of Environment, Government of India for the Award of this prestigious Fellowship.

The author is thankful to Director, National Botanical Research Institute, Lucknow for all infrastructural facilities and to Sri S.C. Srivastava, Research Assistant for help in reference work. Thanks are due to several agrostologists and other taxonomists, who responded to authors enquiries about taxonomy or distribution of grasses and to Dr. T.R. Soderstroem of Washington, Dr. W.T. Clayton of Kew, Dr. N.C. Nair of Coimbatore, Dr. R.R. Rao of Dehradun and Mr. D.C. Pal of Calcutta, who kindly supplied copies of some literature.

APPENDIX I

GENERA OF GRASSES AND NUMBER OF THEIR SPECIES IN INDIA

(The figure inside bracket is the number of exotic taxa)

Name of Genus	*No. of Species*	*Name of Genus*	*No. of Species*
Acrachne Wt. & Arn.	1.	*Crypsis* Aiton	1
Acroceras Stapf	3	*Cyathopus* Stapf	1
Aegilops L.	1	*Cymbopogon* Spreng.	20
Aeluropus Trin.	1	*Cynodon* Rich.	4
Agropogon Fourn.	1	*Cynosurus* L.	(2)
Agropyron Gaertn.	2	*Cyrtococcum* Stapf	7
Agrostis L.	22	*Dactylis* L.	1
Aira L.	(1)	*Dactyloctenium* Willd.	3
Alloteropsis Presl	2	*Danthonia* DC.	2
Alopecurus L.	6	*Danthonidium* Hubb.	1
Andropogon L.	6(2)	*Dendrocalamus* Nees	8
Anthoxanthum L.	4(1)	*Deschampsia* Beauv.	2
Apluda L.	1	*Desmostachya* Stapf	1
Apocopis Nees	4	*Deyeuxia* Beauv.	11
Aristida L.	10	*Dichaetaria* Steud.	1
Arrhenatherum Beuv.	1	*Dichanthium* Willew.	29
Arthraxon Beauv.	25	*Diectomis* Kunth	1
Arundinaria Mich.	9	*Digitaria* Hall	25(3)
Arundinella Raddi	20	*Dignathia* Stapf	1
Arundo L.	1	*Dimeria* Br.	27
Aulacolepis Hack.	1	*Dinebra* Jacq.	1
Avena L.	(5)	*Dinochloa* Buse	3
Axonopus Beauv.	2	*Diplachne* Beauv.	1
Bambusa Schreb.	16	*Drepanostachyum* Keng f.	2
Bhidea Bor	1	*Duthiea* Hack.	1
Bouteloua Lagasea	(3)	*Echinochloa* Beauv.	6(1)
Brachiaria Griseb.	20	*Ehrharta* Thunb.	1
Brachypodium Beauv.	2	*Eleusine* Gaertn.	2
Briza L.	(3)	*Elymus* L.	15
Bromus L.	16	*Elionurus* Willd.	1
Calamagrostis Adans.	10	*Elytrophorus* Beauv.	1
Capillipedium Stapf.	1	*Enneapogon* Beauv.	4
Catabrosa Beauv.	1	*Enteropogon* Nees	2
Catabrosella Tzvel.	1	*Eragrostiella* Bor	5
Cenchrus L.	8	*Eragrostis* Wolf.	30(3)
Centotheca Desv.	1	*Eremochloa* Buse	1
Centropodia Reichb.	1	*Eremopoa* Roshev.	2
Cephalostachyum Munro	5	*Eremopogon* Stapf	1
Chandrashekharania Nair *et al.*	1	*Eremopyrum* Jaub. & Spach.	3
Chimonobambusa Makino	9	*Eriachne* Br.	1
Chionachne R. Br.	2	*Eriochloa* Kunth	2
Chloris Sw.	9(1)	*Eriochrysis* Beauv.	1
Chrysopogon Trin.	15	*Euchlaena* Schrad.	(1)
Cleistachne Benth.	2	*Euclasta* Franch.	1
Coelachne R. Br.	3	*Eulalia* Kunth	14
Coelachyropsis Bor	1	*Eulaliopsis* Honda	2
**Coelorhachis* Brong.	3	*Festuca* L.	25
Coix L.	4	*Garnotia* Brong.	12
Colpodium Trin.	1	*Germainia* Bal. & Poit.	1
Cortaderia Stapf	(1)	*Gigantochloa* Munro	2

Name of Genus	*No. of Species*
Glyceria Bor	2
Glyphochloa Clayton	8
Gymnopogon Beauv.	1
Hackelochloa Kuntze	2
Halopyrum Stapf	1
Helictotrichon Schult.	3(1)
Hemarthria Br.	5
Hemisorghum Bor	1
Heteropholis Hubb.	1
Heteropogon Pers.	6
Hierochloe R. Br.	3
Holcolemma Stapf & Hubb.	1
Holcus L.	(2)
Hordeum L.	5(2)
Hubbardia Bor	1
Hyalopoa Tzvel.	1
Hygroryza Nees	1
Hymenachne Beauv.	2
Hyparrhenia Four.	3(1)
Hystrix Moench.	1
Ichnanthus Beauv.	1
Imperata Cyr.	1
Indocalamus Nakai	2
Indopoa Bor	1
Isachne Br.	29
Ischaemum L.	40
Iseilema Anderss.	6
Jansenella Bor	1
Kengia Packer	1
Koeleria Pers.	2
Lagurus L.	(1)
Lamarckia Moench.	(1)
Lasiurus Boiss.	1
Leersia Sw.	3
Leptaspis Br.	1
Leptochloa Beauv.	5
Leptothrium Kunth	1
Lepturus R. Br.	2
Leymus Hochst.	1
Limnopoa Hubb.	1
Lolium L.	5(1)
Lophathorum Brong.	1
Lopholepis Decne.	1
Lophopogon Hack.	2
Lygeum L.	1
Manisuris L.	1
Melanocenchris Nees	3
Melica L.	5
Melinis Beauv.	(1)
Melocanna Trin.	1
Microcalamus Franch.	1
Microchloa Br.	2
Microstegium Nees	6
Milium L.	1
Miscanthus Anderss.	3
Mnesithea Kunth	1
Muhlenbergia Schreb.	3(1)
Myriostachya Hook.f.	1
Narenga Bor	2
Neohouzeana Camus	2
Neyraudia Hook.f.	2
Normanboria Butzin	1
Ochlandra Thw.	8
Ochthochloa Edgew.	1
Ophiuros Gaertn. f.	3
Oplismenus Beauv.	3
Orinus Hitch.	1
Oropetium Trin.	1
Oryza L.	8
Ottochloa Dandy	1
Oxytenanthera Munro	5
Panicum L.	29
Paracolpodium Tzvel.	1
Parahyparrhenia Camus	1
Parapholis Hubb.	1
Paspalidium Stapf	3
Paspalum L.	7
Pennisetum Rich.	12(1)
Perotis Aiton	2
Phacelurus Griseb.	2
Phaenosperma Benth.	1
Phalaris L.	1(1)
Phalaroides Wolf	1
Phippsia Br.	1
Phleum L.	4(1)
Phragmites Adans.	2
Phyllostachys Sieb. & Zucc.	3(1)
Piptatherum Beauv.	6
Poa L.	45(1)
Pogonachne Bor	1
Pogonatherum Beauv.	4
Polypogon Desf.	2
Polytoca Br.	2
Polytrias Hack.	1
Pommereulla L. f.	1
Porteresia Tateoka	1
Pseudanthistiria Hook.f.	4
Pseudechinolaena Stapf	1
Pseudobrachiaria Laun.	1
Pseudodanthonia Bor & Hubb.	1
Pseudodichanthium Bor	1
Pseudopogonatherum Camus	1
Pseudoraphis Griff.	3
Pseudosorghum Camus	1
Pseudostachyum Munro	1
Puccinellia Parl.	6
Rhynchelytrum Nees	1
**Robynsiochloa* Jacq. Fel.	1

Name of Genus	*No. of Species*
Rostraria Trin.	3
Rottboellia L.F.	1
Saccharum L.	11(2)
Sacciolepis Nash	4
Schismus Beauv.	2
Schizachyrium Nees	6
Schizostachyum Nees	1
Schoenefeldia Kunth	1
Sclerachne Br.	1
Sclerochloa Beauv.	1
Scleropoa Griseb.	1
Sclerostachya Camus	2
Secale L.	(2)
Sehima Forssk.	3
Semiarundinaria Nakai	1
Setaria Beauv.	12(4)
Silentvalleya Nair et al.	1
Sinobambusa Makino	1
Sorghastrum Nash	(1)
Sorghum Moench.	6(2)
Spartinia Schreb.	1
Sphaerocaryum Hook. f.	1
Spinifex L.	1
Spodiopogon Trin.	5
Sporobolus R. Br.	17(1)
Stenotaphrum Trin.	1
Stipa L.	20
Stipagrostis Nees	3
Streptogyna Beauv.	1
Teinostachyum Munro	2
Tetrapogon Desf.	2
Thamnocalamus Munro	4
Thaumastochloa Hubb.	1
Thelepogon R. & S.	1
Themeda Forssk.	17
Thuarea Pers.	1
Thyrsostachys Gamble	(1)
Thysanolaena Nees	1
Trachys Pers.	1
Tragus Haller	1
Trichloris Benth.	2
Tricholaena Schultes & Schultes	1
Trikeria Bor	1
Trilobachne Henr	1
Triplopogon Bor	1
Tripogon R. & S.	12
Trisetaria Forssk.	1
Trisetum Pers.	6
Triticum L.	2(1)
Urochloa Beauv.	2
Urochondra Hubb.	1
Vetiveria Lem.-Lisane	2
Vossia Wall. & Griff.	1
Vulpia Gmel.	3
Zea L.	1
Zenkeria Trin.	4
Zizania L.	1
Zovsia Willd.	1

*Recently, Veldkamp et al. (1986) have reduced *Coelorhachis* and *Hackelochloa* to *Mnesithea* and *Robynsiochloa* to *Rottboellia*; this is not adopted here.

APPENDIX II

ENDEMIC TAXA, WHICH ARE ALSO RARE

Agropyron duthiei Meld.
Agrostis schmidii (Hook.f) Fischer
Andropogon longipes Hack.
Anthoxanthium borii Jain & Pal
Arthraxon depressus Stapf
Arthraxon meeboldii Stapf
Arundinaria mannii Gamble
Arundinaria rolloana Gamble
Arundinella setosa Trin. var. *lanifera* Fisch.
Arundinella tuberculata Munro ex Lisboa
Arundinella vaginata Bor
Bambusa mastersii Munro
Bhidea burnsiana Bor
Brachairia nilagirica Bor
Cenchrus prieurii (Kunth) Maire var. *scabra* Bhandari
Cenchrus rajasthanensis Konodia & Nanda.
Chimonobambusa jaunsarensis (Gamble) Bahadur & Naithani
Chrysopogon velutinus (Hook.f.) Bor.
Cleistachne stocksii Hook.f.
Coelachne minuta Bor
Cyathopus sikkimensis Stapf
Cymbopogon osmastonii Parker
Cynodon barberi Rang. & Tad. f. *longifolius* Jain
Danthonidium gammiei (Bhide) Hubb.
Dendrocalamus hookeri Munro var. *parishii* (Munro) Blatter
Deyeuxia nagarum Bor
Dichanthium concanensis (Hook.f.) Jain & Deshp.
Dichanthium filiculme (Hook.f.) Jain & Deshp
Dichanthium foulkesii (Hook.f.) Jain & Deshp.
Dichanthium maccannii Blatt.
Dichanthium oliganthum (Hochst. ex Steud.) Cope
Dichanthium panchganiense Blatt. & McCann
Dichanthium planipedicellatum (Bor) Jain & Deshp.
Digitaria jubata (Griseb.) Henr.

Digitaria tomentosa (Koen. ex Willd.) Henr.
Dimeria acutipes Bor
Dimeria bialata Fischer
Dimeria blatteri Bor
Dimeria deccanensis Bor
Dimeria fischeri Bor
Dimeria hohenackeri Hochst. ex Miq.
Dimeria lawsonii (Hook.f) Fischer
Dimeria mooneyi Raiz. ex Mooney
Dimeria orissae Bor
Dimeria stapfiana Hubb. ex Pilger.
Eragrostiella leioptera (Stapf) Bor
Eragrostis rottleri Stapf
Eriochrysis rangacharii Fischer
Eulalia wightii (Hook. f.) Bor
Garnotia arborum Stapf
Garnotia puchiparensis Bor
Garnotia schmidii Hook. f.
Glyphochloa acuminata (Hack.) Clayton var. *woodrowii.*
Heteropogon fischerianus Bor
Heteropogon polystachyos (Roxb.) Schult.
Heteropogon ritchiei (Hook.f.) Blatt.
Hubbardia heptaneuron Bor
Indopoa paupercula (Stapf) Bor
Isachne angladei Fischer
Isachne borii Hemadri
Isachne deccanensis Bor
Isachne dimyloides Bor
Isachne fischeri Bor
Isachne gracilis Hubb.
Isachne lisboae Hook.f.
Isachne meeboldii Fischer
Isachne mysorensis Sundar Raghavan
Isachne oreades (Domin) Bor
Isachne setosa Fischer
Ischaemum bombaiense Bor
Ischaemum flumineum Bor
Ischaemum impressum Hack.
Ischaemum kingii Hook.f.
Ischaemum lisboae Hook.f.
Ischaemum pilosum (Klein ex Willd.) Wt.
Ischaemum rangacharianum Fischer
Ischaemum santapaui Bor
Ischaemum thomsonianum Stapf
Ischaemum travancorense Stapf
Ischaemum tumidum Stapf
Iseilema anthephoroides Hack.
Limnopoa meeboldii (Fischer) Hubb.
Lophopogon tridentatus (Roxb.) Hack. var. *duthiei* Bor
Normanboria henrardiana (Bor) Butzin
Ochlandra beddomei Gamble
Ochlandra ebracteata Raizada & Chatterjee
Ochlandra scriptoria (Dennst.) Fischer
Ochlandra sivagiriana (Gamble) Camus
Ochlandra talbotii Brandis
Ochlandra travancorica Benth.
Ophiuros bombaiensis Bor
Oropetium roxburghianum (Steud) Phillips.
Oropetium villosulum Stapf
Oryza jeyporensis Govind. & Krishna.
Oxytenanthera bourdilloni Gamble
Oxytenanthera ritcheyi (Munro) Blatt. & Mc Cann
Panicum fischeri Bor
Panicum khasianum Munro ex Hook. f.
Parahyparrhenia bellariensis (Hack.) Clayton
Phyllostachys assamica Gamble
Poa gamblei Bor
Poa pseudamoena Bor
Poa rhadiana Bor
Pogonachne racemosa Bor
Pseudodanthonia himalaica (Hook. f.) Bor
Pseudodichanthium serrafalcoides (Cooke & Stapf) Bor
Schizachyrium impressum (Hack.) Camus
Schizostachyum rogersii Brandis
Sehima sulcatum (Hack.) A. Camus
Sorghum deccanense Stapf
Teinostachyum beddomei Fischer
Themeda mooneyi Bor
Themeda saxicola Bor
Trilobachne cookei (Stapf) Schenck ex Henr.
Tripogon jacquemontii Stapf
Tripogon lisboae Stapf
Tripogon pungens Fischer
Tripogon wightii Hook. f.
Trisetum micans (Hook. f.) Bor

REFERENCES

ACHARIAR, K.R. AND C.T. MUDALIAR, A hand book of South Indian Grasses pp. 318 Madras. 1921.

BLATTER, E.J. AND C. McCann. The Bombay Grasses Pub. no. 5 of Sci. Monogr. of Imp. Counc. Agric. Res. India. 1935.

BOR, N.L. The Flora of Assam — Vol. 5 (Gramineae) Calcutta. 1940.

——— Some Common U.P. Grasses. *India For. Rec.* n.s. (Bot) 2 : 1-220. 1941.

——— Grasses of Burma, Ceylon, India & Pakistan. Acad. Press. London. 1960.

CHAUDHURY, A.B. Grasses and grassland types of central forest division, West Bengal. *Indian For.* 85 : 603-606. 1959.

——— Common grasses and sedges of Kurseong. Kalimpong and Darjeeling forest division, West Bengal. *Ibid.* 86 : 336-353. 1960.

COLDSTREAM Illustrations of the grasses of the South Punjab. Edinburgh. 1889.

DESAI, M.C. AND S.N. MURTHY. Some grasses of Dharwar Agriculture College Estate. *Dharwar Agri. Coll. Mag.* 4 : 27. 1950.

DESHPANDE, U.R. Poaceae Tribe Andropogoneae-Dichanthium. *Fl. India Fasc.* 15. Bot. Surv. India. Calcutta. 1-30. 1984.

DUTHIE, J.F. A. list of the grasses of N.W. India, Indigenous and cultivated. Roorkee. 1883.

——— Illsutrations of the indigenous fodder grasses of the plains of N.W. India. Roorkee. 1886.

——— The Fodder grasses of Northern India. Roorkee. 1888.

FERGUSON, W. Indigenous Grasses of Ceylon. *J. Ceylon Br. Asiat. Soc.* 6 : 1-28. 1881.

FISCHER, C.E.C. Gramineae in J.S. Gamble's Flora of Madras Pt. X, pp. 1689-1864. 1934.

GRIFFITH, W. Grasses of jheels of Sylhet. *J. Asiat. Soc. Beng.* 5 : 570. 1834.

HOOKER, J.D. AND O. STAPF. Flora of British India. Vol. 7-Gramineae. London. 1896.

JAIN, S.K. A contribution to the bibliography of Gramineae. *Proc. Nation. Acad. Sci. India* 31 B : 316-382. 1961.

——— The Genus *Cynodon* Rich. ex Pers. in India. *Bull. Bot. Surv. India* 9 : 134-151. 1967.

——— Notes on India Grasses, VII. The Genus *Oropetium* Trin. in India. *Ibid.* 9 : 284-285. 1967.

——— The Genus *Manisuris* L. (Poaceae) in India. *Ibid.* 12 : 6-17. 1970.

——— The genus *Arthraxon* P. Beauv. (Poaceae) in India. *J. Ind. Bot. Soc.* 51 : 165-183. 1972.

——— On the Status of endemism of some grasses in India. *Ibid.* 1986.

———, D.K. BANERJEE AND D.C. PAL. Grasses of Bihar, Orissa, and West Bengal. *J. Bombay Nat. Hist. Soc.* 72 : 758-773. 1975.

———, DOLI DAS AND D.K. BANERJEE. Further Contribution to the Bibliography of grasses. *Bull. Bot. Surv. India* 14 : 24-45. 1972.

——— AND D.C. PAL. New species and notes on the genus *Anthoxanthum* L. *J. Bombay Nat. Hist. Soc.* 72 : 90-95. 1975.

——— AND R.R. RAO (Ed.) An Assessment of Threatened Plants of India, Bot. Surv. India; Calcutta. 1983.

——— AND A.R.K. SASTRY. Threatened Plants of India — A State-of Art Report. Bot. Surv. India. Calcutta. 1980.

——— AND ——— Materials for a Catalogue of Threatened Plants of India. Bot. Surv. India, Calcutta. pp. 1-69. 1983.

——— AND S.C. SRIVASTAVA. Additions to Grass Flora of India. *J. Econ. Tax. Bot.* 1986.

KAPADIA, G.A. Notes on some grasses from Janugadh. *J. Bombay Nat. Hist. Soc.* 45 : 259-262. 1945.

KARTHIKEYAN, S. Endemic Grasses of India with an emphasis or rare, indeterminate and extinct species, in S.K. Jain & R.R. Rao (Eds.) An Assessment of Threatened Plants of India: Bot. Surv. India Calcutta pp. 240-250. 1983.

LISBOA, J.C. List of Bombay Grasses and their uses, Bombay 1896.

MAJUMDAR, R. Studies on the grasses of 24-Parganas (W.B.) *Bull. Bot. Soc. Bengal* 10 : 1-114, 1956.

PATUNKAR, B.W. Grasses of Marathwada, Sci. Publ. Jodhpur. 1980.

RAIZADA, M.B., R.C. BHARADWAJA AND S.K. JAIN. Grasses of the Upper Gangetic Plains — panicoideae pt.-1 *Indian For. Rec.* (Bot.) 4 : 171-277. 1961.

—— AND S.K. JAIN. Grasses of the Upper Gangetic Plains-Panicoideae. pt.-II . *Ibid.* 5 : 151-226 . 1964.

RHIND, D. The Grasses of Burma, Calcutta. 1945.

ROY, G.P. *Grasses of Madhya Pradesh,* Calcutta. 1984.

SYMONDS, T.J. Indian Grasses Ed. 2. Madras, 1886.

TIWARI, S.D. N. Grasses of Madhya Pradesh. *Indian For.* 80 : 601-611, 681- 689.1954.

—— Grasses of Madhya Pradesh, *Ibid.* 81 : 107-115, 191-200. 1955.

VED PRAKASH AND S.K. JAIN. Poaceae : Tribe Garnotieae. *Fasc. Fl. India* No. 3 pp. 1-16. Bot. Surv. India Calcutta. 1979.

—— AND —— Poaceae : Tribe Isachneae *Fasc. Fl. India* 14. Bot. Surv. India, Calcutta. pp. 1-42. 1984.

——, U. SHUKLA, D.C. PAL AND S.K. JAIN. Additions to the Indian grass flora in last 2 decades. *Bull. Bot. Surv. India* 20 : 143-147. 1978.

VELDKAMP, J.F., R. DE KONING AND M.S.M. SOSEF. Generic delimitation of *Rottboellia* and related genera (Gramineae). *Blumea* 31 : 281-307. 1986.